
Space Weather Technical Forecast

Issued on Monday, 29 August 2022 at 13:25 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: M-class flares (R1-R2) likely at first. Chance of G1/Minor Storm day 1. Chance of further Minor Radiation storms (S1).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Moderate, with the background X-ray trace at GOES16 comfortably residing at C-class levels. Further M-class flares were observed from AR3088 (Ekc/Beta-Gamma) which has now rotated around the southwest limb. Two R2 Flares were observed, the largest impulsive M8.6 was observed at 29/1107 UTC and a long period M6.7 at 28/1619 UTC, the latter of which gave a coronal mass ejection (CME) that has been analysed as missing ahead of Earth. AR3089 (Eki/Beta-Delta) in the southeast, is currently the largest and most complex region on the disk, with a delta spot configuration. AR3085, AR3086 and AR3087 are all simple with little overall change observed. No other Earth-directed CMEs were observed occurring in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, was at slightly elevated levels initially, around 460 km/s due to the high speed stream (HSS) related to CH18/-. The waning effects of CH18 let solar wind speeds drop to background levels, 380 km/s, before rising again by 29/0300 UTC to slightly elevated levels due to the likely glancing blow of a CME which left the sun on the 27th. This was then followed by the probable arrival of CH17/- late in the AM of 29th UTC allowing solar winds speeds to become Elevated, around 500-520 km/s. The associated density was near average until 29/0300 UTC when it became above average until 29/0645 UTC, when it fell back to average. The total interplanetary magnetic field (IMF), Bt, was at weak to moderate levels, with no sustained negative periods observed in the north-south component, Bz, which fluctuated between +9/-10nT. The phi angle was negative (towards the Sun) throughout. Geomagnetic activity was therefore Quiet to Active (Kp1-4).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV), as measured by GOES-16 was slightly elevated but remained well below S1/Minor Radiation storm levels. The high energy electron flux (greater than 2 MeV) remained at Background levels. The 24-hour integrated electron fluence remained below the Active threshold (1e8 integrated pfu) with a downward trend noted and 1.46e6 integrated pfu observed at 29/0000 UTC.

Four-Day Space Weather Forecast Summary

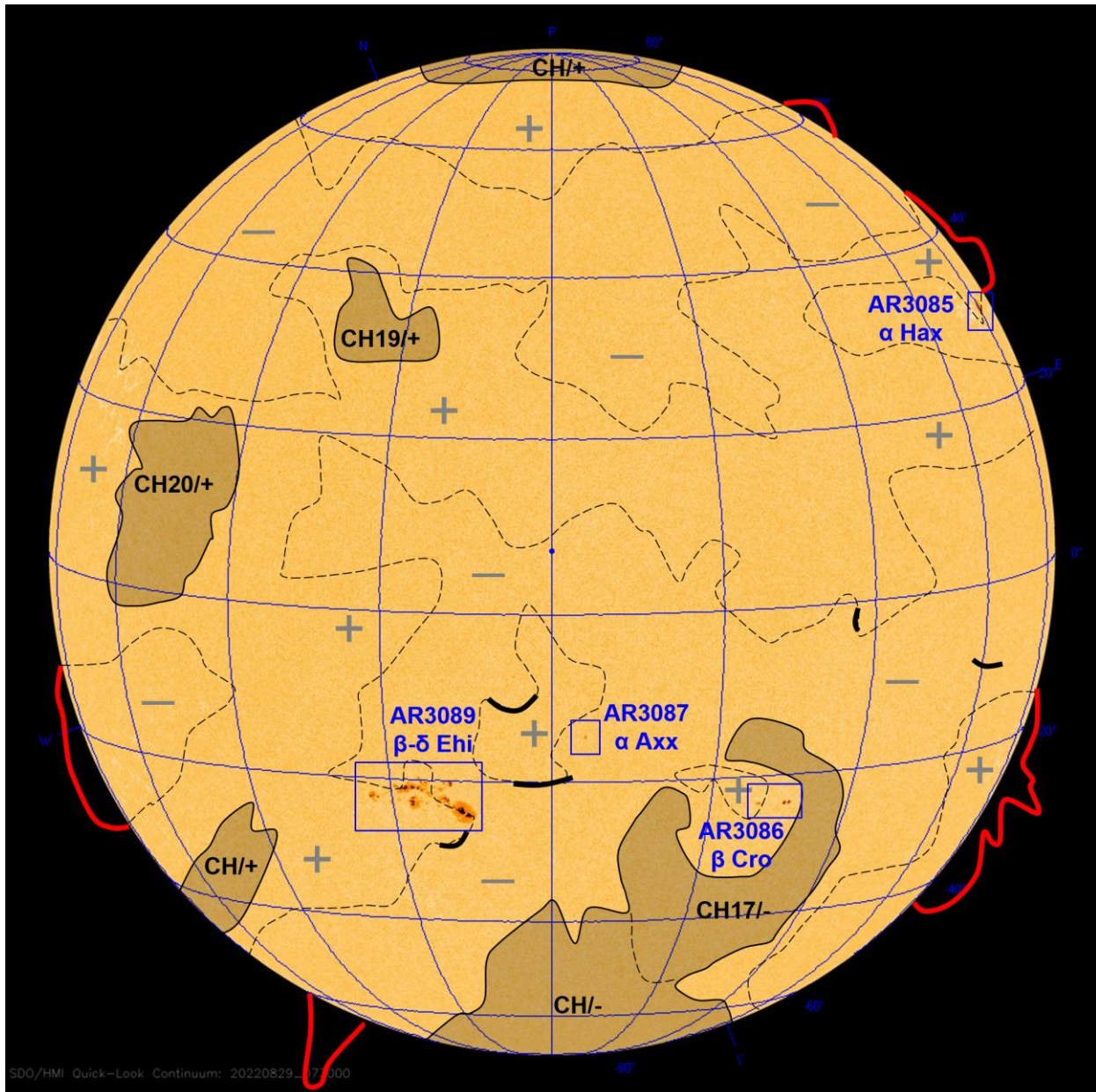
Solar Activity: Further M-class flares are likely with a slight chance of an isolated X-class flare. This risk will probably decrease through the period as the main sunspot in the southwest AR3088 continues to rotate off the disc, however the sunspot in the southeast AR3089 will need to be monitored for any further development.

Solar Wind / Geomagnetic Activity: Ongoing coronal hole HSS enhancements are possible from CH17/- during the next two days (29th and 30th), with the slightly elevated or elevated solar winds only gradually easing from day 3 (31st) onward. Geomagnetic Activity is expected to be Unsettled to Active at first, gradually becoming Quiet. There remains a chance of G1/Minor Storms due to the ongoing connection to CH17/-. Mainly Quiet geomagnetic conditions expected from day 3 (31st).

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

Energetic Particles / Solar Radiation: High energy protons (greater than 10MeV) are expected to remain slightly elevated but below the S1/Minor Radiation storm levels, with a chance of further enhancements, mainly from any notable flares from AR3088 days 1 and 2 (29th and 30th). The high energy (greater than 2 MeV) electron flux forecast is expected to remain mostly at background, but likely rising again to Moderate, perhaps peaking High, once any fast wind enhancement or CME influence fades by day 3 (31st Aug). The associated 24 hour fluence is expected to remain below the Active (1e8 integrated pfu) threshold, but with a chance (20 to 30%) of rising above towards the end of the guidance period.

Figure 1. Solar Analysis Valid 29/0800 UTC.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-γ-δ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

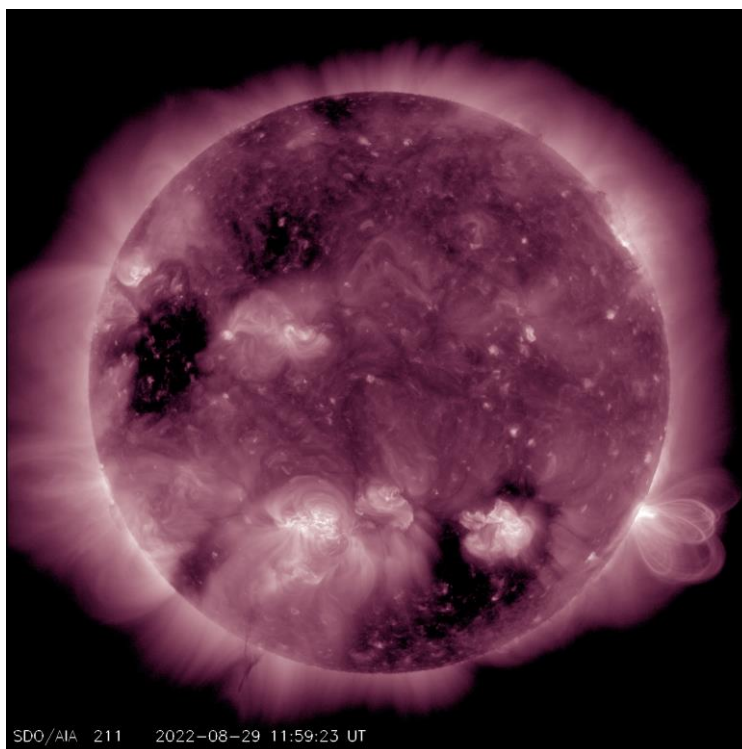
The CME from 27th seems to have given Earth a glancing blow as expected early on 29th UTC, with limited geomagnetic response.

Earth is currently in a Elevated solar wind regime (500-520 km/s) due to the likely onset of CH17/- in recent hours. This is a broad feature, with elevated solar winds expected to persisted until day 3 (31 Aug) similar to persistence, which is currently considered to be giving good guidance.

Geomagnetic Activity is expected to be Unsettled to Active at first, gradually becoming Quiet. There remains a chance of G1/Minor Storms due to the ongoing connection to CH17/-. Mainly Quiet geomagnetic conditions expected from day 3 (31st).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	40	20	1	1
Strong	G3	No	15	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: SDO AIA 211 imagery showing coronal hole 17/- in the southwest limb. Partly obscured by a sunspot.



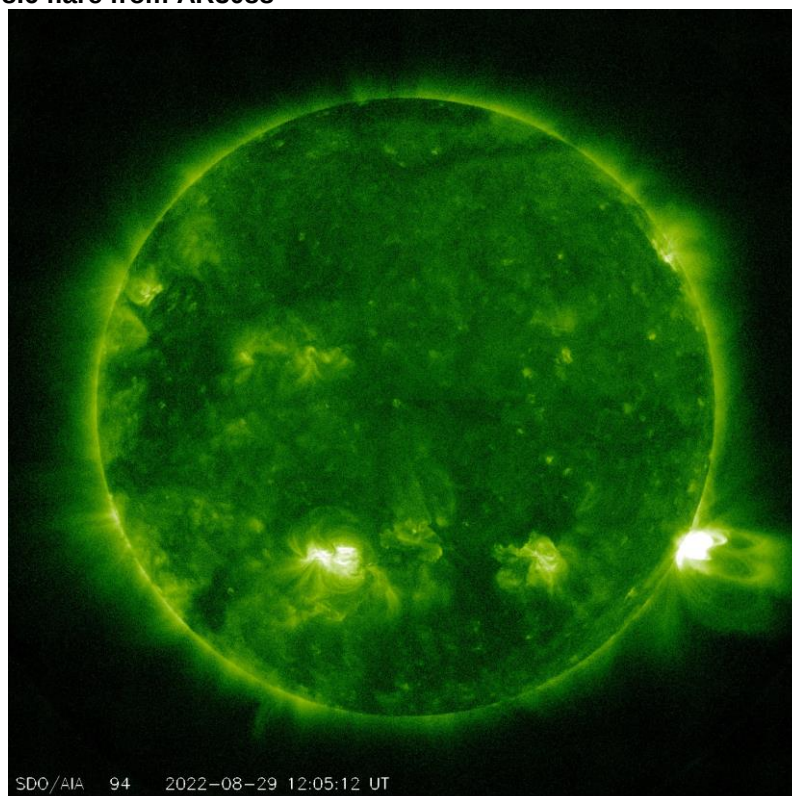
Radio Blackouts - X-Ray Flares:

Solar Activity remains Moderate with a few M-class flares observed, originating from AR3088 (Ekc/Beta-Gamma). This region has now disappeared around the southwest limb, yet flaring remains evident. Any further notable flaring has the potential to still impact Earth until day 2 (30th), due to the magnetic looping above the spot. Further M-flares are likely from this region, and a chance (20%) of X-class flares.

AR3089 (Eki/Beta-Gamma-Delta) in the southeast has also seen some increased magnetic complexity with the emergence of an opposite polarity sunspot near its main positive trailer spot, along with a proliferation of other spots. This has resulted in the formation of a small delta spot. Furthermore, this region has a history of higher M-flares (R2) flares (on the 26th) and any further growth will also give a risk of Moderate to Strong flares. However, no significant activity has currently been observed, since the 26th. There are three other sunspot regions on the disc, however these are smaller and simpler.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	30	30	30
Very Active	R3 to R5 X Class	No	20	5	5	5

Figure 3: Recent M8.6 flare from AR3088



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) has returned to background after reaching the S1 level due to an M4.7 flare from AR3089 on the 27th, with a peak of 28pfu at 27/1220UTC.

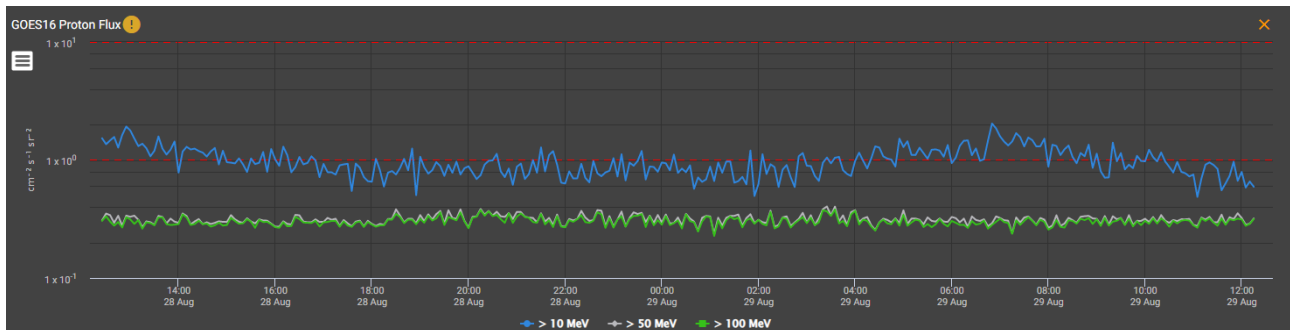
This shows the potential for any flaring from this active region to offer a chance of further S1 or greater through the coming days. Although this region will rotate further around the western limb in coming days, with a subsequent gradual reduction in proton storm risk.

There is also further slight risk of proton storms as AR3089 moves across the visible disc onto the western hemisphere, and this region will need to be monitored for further development.

Radiation Storms	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	30	20	10	5
Very Active	$\geq \text{S3}$ *	No	5	5	1	1

* $\text{S3} \geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)

Figure 4: Proton Trace past 24 hours



High Energy Electrons Event ($\geq 2\text{MeV}$):

The high energy (greater than 2 MeV) electron flux as observed by GOES-16, has remained at background after recent solar wind enhancement and proton storming. Recent CME and HSS activity has the potential to increase electron flux once any subsequent geomagnetic activity subsides. However persistence from the previous rotation, suggests very little electron flux enhancement is likely from the fast wind of CH17.

Consequently, the associated 24 hour electron fluence is expected to remain below the Active threshold, with only a chance (20-30%) of rising above, mainly from day 2 (30 Aug) onward. This supported by the output from Met Office REFM, although this model doesn't take account either the CME or fast wind enhancements, so is likely to be offering rather poor guidance.

GEO Electron Environment	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2\text{ MeV}$ $\geq 1 \times 10^8$	No	10	20	20	30
Very Active	$\geq 2\text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1